April 16, 2001

NRA RTO-22 Final Report

This final deliverable under NRA RTO-22, Free Flight Simulation Traffic Scenario Development, has built on the previous January 2001 deliverable. That deliverable consisted of the following:

- A summary list of the scenarios that were created
- A set of descriptions for the scenarios
- Spreadsheets defining the metrics and variables which were utilized in formulating the scenarios
- Scenario files which can be run in WinTmx to demonstrate execution of the scenarios

The purpose of the work since January has been twofold. First, to implement the same scenarios in FastWin, as a first step toward being able to run them using NASA Langley's ASTOR airborne pilot station. Second, to use WinTmx as a prototyping platform in this process, and, as far as possible, make the two scenario implementations do the same thing on the two different platforms. We could not fully implement several scenarios in FastWin due to a limitation of the software version in the SRC laboratory, and these problems are documented below. Based on conversations with NASA Langley staff, these problems are particular to our software version and will not occur in the forthcoming ASTOR system.

The summary list of scenarios (file Scenario Summary.doc) is updated from the January 2001 delivery, with minor changes. There are still 12 experimental areas defined with 20 total scenarios constructed. The scenarios are titled 1a, 1b, 2a etc. in accordance with the summary list. The scenarios are described individually in a series of documents titled ES1a.doc, ES1b.doc, etc. which are contained in the file Scenario Descriptions.zip.

Each scenario has a TMX representation. The TMX scripts are titled scn1a.scn, etc. and are contained in TMXscript.zip. Each TMX script is incorporated into the corresponding scenario description for ease of reading. The TMX scenarios should be run using WinTmx version 5.36 or later, since several of these use the new polygon definition capability for restricted areas.

FastWin Representation

The scenarios were translated into FastWin format using the FFSim configuration in the SRC laboratory. The configuration allows either a single pilot station or two pilot stations to be run in a scenario. There were several scenarios which involve three aircraft. For these cases, the scenario was divided into two FastWin representations with two aircraft each.

The process used to create the same scenario in TMX and FastWin was as follows. Company routes were defined for the aircraft in each scenario and run in TMX, then adjusted for creating aircraft-aircraft conflicts when called for in the scenario. The routes and initial points were then created for FastWin aircraft and operated within the FFSim configuration. If the FastWin results were not satisfactory, for example a route could not be created or aircraft conflict detection did not occur, modifications were made to both the TMX and the FastWin representation until the scenario execution was correct in both representations.

There are three limitations of the version of FastWin which SRC has within the FFSim. First, there is no representation of weather or other restricted areas. For the scenarios involving these areas we have created an aircraft heading toward the area as shown in TMX. Second, there is only one aircraft dynamics model, for a B757. All scenarios have been set for this aircraft type although in some cases the scenario would be improved if differing aircraft types were involved. Third, the following scenarios involve climbing and/or descending aircraft: 1b, 3a, 3b, 3c, 4a, and 4b. The FastWin version which we have does not obey crossing restrictions at waypoints, resulting in lack of control of aircraft in those scenarios. We realized this fact too late to enable a corrected version to be set up in our laboratory.[1] Therefore, the FastWin scenarios have created aircraft which travel correct routes but at constant, and differing, altitudes. These scenarios need to be amended for crossing restrictions requiring descents and climbs to realize the conditions shown in the TMX versions.

Figure 1 is a spreadsheet listing all the scenarios with the aircraft definition, flight number, company route, and customic.dat (initialization) file number for each of the two pilot stations. The company route file (companyr.dat) and customic.dat file are part of this deliverable. In some cases, the company routes had crossing restrictions built in but they could not be tested with our simulation environment as discussed in the previous paragraph. Comments are added where necessary.

[1] This was determined through communications with Dave Williams of NASA Langley.

			Pilot Station 1				Pilot Station 2		
Scenario	Aircraft Definition Identifier	Flight Number	Company Route	Customic.dat file number	Aircraft Definition Identifier	Flight Number	Company Route	Customic.dat file number	Comments
1a									Not able to properly represent this scenario in FFSim
1b	scn1b1	DAL300	KELPKDFW002	5	scn1b2	AAL100	KFSTKDFW001	6	differing altitudes
1b	scn1b1	DAL300	KELPKDFW002	5	scn1b3	USA200	KTCSKFST001	7	differing altitudes
2a	scn2a1	DAL111	KMEMKDFW101	8					
2b	scn2b1	DAL111	KMEMKDFW101	9					
2c	scn2c1	DAL111	KMEMKDFW101	10					
3a	scn3a1	DAL300	KELPKDFW201	11	scn3a2	AAL100	KMEIKELP001	12	differing altitudes
3a	scn3a3	USA200	KABQKACT001	13	scn3a1	DAL300	KELPKDFW201	11	differing altitudes
3b	scn3b1	DAL300	KDFWKJAN001	14	scn3b2	USA200	KLFKKMEM001	15	differing altitudes
3c	scn3c1	DAL300	KDFWKMEI001	16	scn3c2	AAL100	KMGMKDFW101	17	differing altitudes
3c	scn3c3	USA200	KLFKKMEM101	18	scn3c1	DAL300	KDFWKMEI001	16	differing altitudes
4a	scn4a1	DAL111	KMEMKDFW101	19	scn4a2	AAL200	KIAHKDFW101	20	differing altitudes
4a	scn4a3	USA300	KIAHKDFW102	21	scn4a1	DAL111	KMEMKDFW101	19	differing altitudes
4b	scn4b1	DAL111	KSTLKCRP002	22	scn4b2	USA300	KMEMKSAT001	23	
4b	scn4b3	AAL200	KMGMKELP001	24	scn4b1	DAL111	KSTLKCRP002	22	
5a	scn5a1	DAL111	KSTLKCRP002	25	scn5a2	USA300	KMEMKSAT001	26	
5a	scn5a3	AAL200	KMGMKELP001	27	scn5a1	DAL111	KSTLKCRP002	25	
6a	scn6a1	DAL111	KDFWKARG001	28					
7a	scn7a1	DAL111	KMEMKDFW101	29	scn7a2	AAL200	KDFWKMEM101	30	
7b	scn7b1	DAL111	KDFWKHEZ001	31					
8a	scn8a1	DAL111	KDFWKJAN002	32					
9a	scn9a1	AAL200	KIAHKDFW003	33	scn9a2	DAL111	KIAHKDFW001	34	crosswinds not modeled
10a	scn10a1	DAL300	KACTKTUL001	35	scn10a2	USA200	KMKCKDFW001	36	
10a	scn10a1	DAL300	KACTKTUL001	35	scn10a3	AAL100	KTXKKOKC001	37	
11a	scn11a1	AAL200	KLAXKDFW001	38	scn11a2	DAL111	KMGMKELP001	39	FastWin routes created ok, but FFSim error when trying to run scenario
12a	scn12a1	AAL200	KLAXKDFW001	40	scn12a2	DAL111	KMGMKELP001	41	ditto
12b	scn12b1	AAL200	KLAXKDFW001	42	scn12b2	DAL111	KMGMKELP001	43	ditto

Figure 1. Scenario Table for FastWin and FFSim